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(54) Abstract Title
Pneumatic tyre

(57) A pneumatic tyre adapted to be quiet in running comprises a plurality of transverse grooves formed in the tyre tread wherein the circumferential distance between adjacent transverse grooves measured along a circumferentially extending straight line is one of at least eight different distances L1-L8.

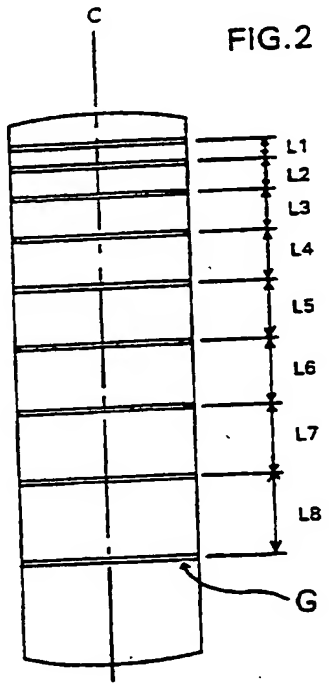


FIG.2

FIG. 1

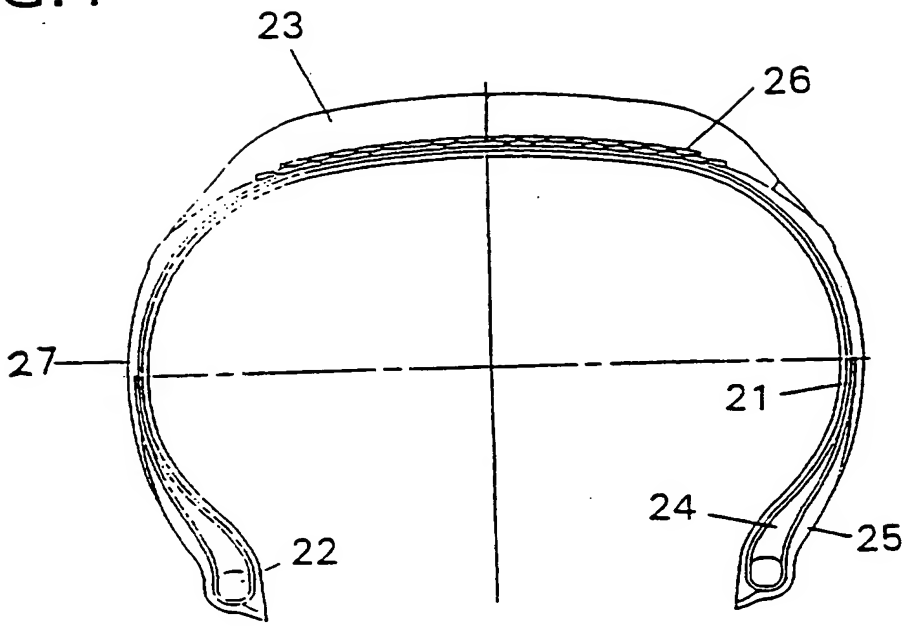


FIG. 2

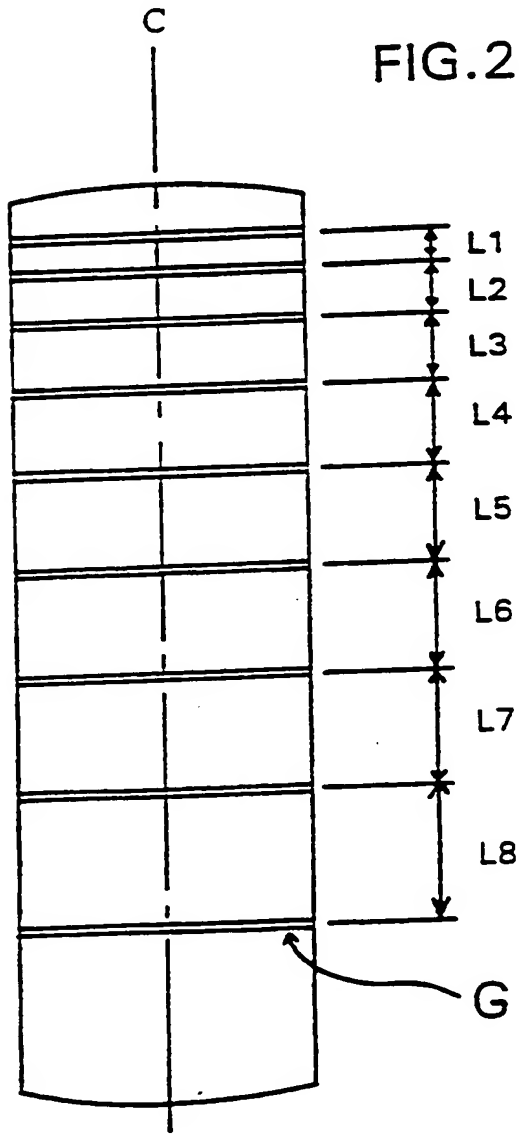


FIG.3

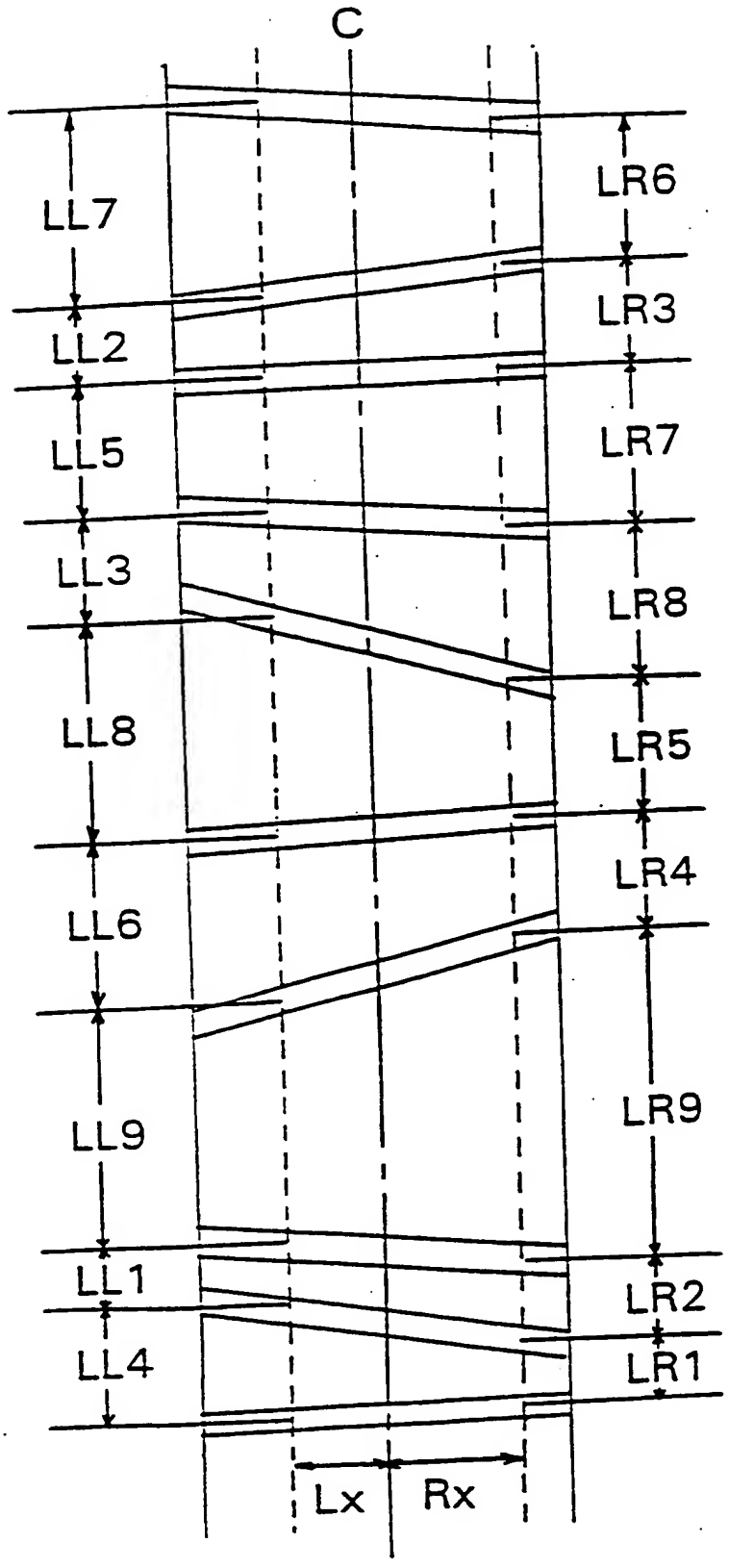
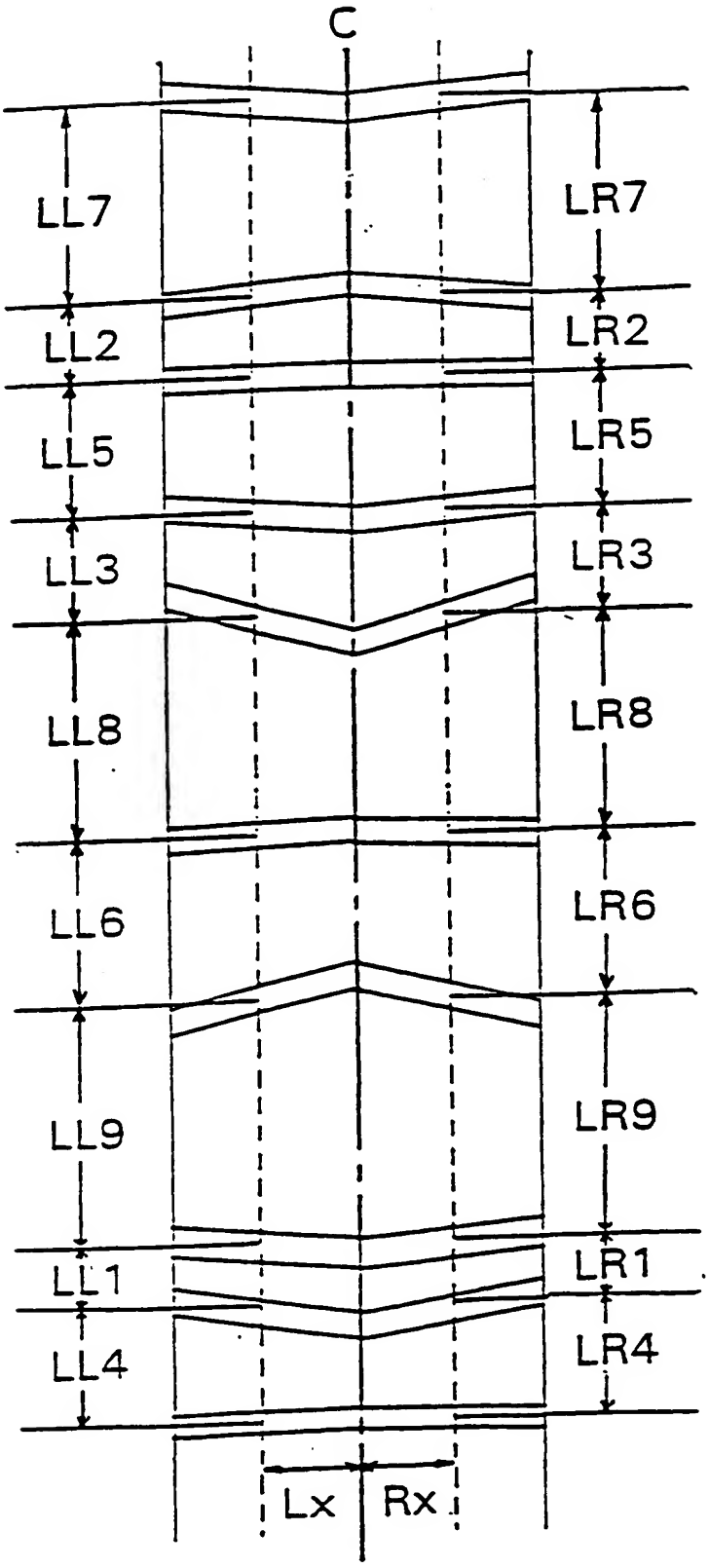

C
LL7
LR6
LL2
LR3
LL5
LR7
LL3
LR8
LL8
LR5
LR4
LL6
LL9
LR9
LL1
LR2
LL4
LR1
Lx
Rx

FIG.4


C
LL7
LR7
LL2
LR2
LL5
LR5
LL3
LR3
LL8
LR8
LL6
LR6
LL9
LR9
LL1
LR1
LL4
LR4
Lx
Rx

However a major problem exists with the conventional approach to noise reduction arising from the conflict between the optimum pitch sequencing of pattern elements and their arrangement in the mould. Many modern tyre patterns are produced in so-called "two-phase" moulds in which groups of pattern elements are arranged in tread mould segments which are movable in the radial direction. In operation these segments, which usually number 8 or 9 around the whole mould circumference, move inward as the mould is closed and outward as the mould is opened enabling deeply patterned tyres to be moulded. The requirement for these segment to comprise an integral number of pattern forming elements and to be of equal circumferential length often constrains the arrangement of pattern elements such that the minimum noise level is not achievable.

Furthermore certain features of the tread pattern such as the angles of grooves or sipes or the shapes of tread blocks will of necessity change with variations in the pitch length of the pattern element. Accordingly the disposition of some features in some pattern elements may not be ideal such that performance of the feature, for example with regard to tread wear, may be compromised.

Accordingly it is an object of the present invention to provide a tyre having a low noise tread pattern which avoids the above-mentioned problems.

According to one aspect of the present invention a pneumatic tyre comprises a ground contacting tread having a plurality of transverse grooves disposed around the tyre circumference characterised in that the circumferential distance between adjacent transverse grooves measured along a circumferentially extending straight line is one of at least eight different distances.

By circumferentially extending straight line is meant the tyre or tread circumferential centreline or any line on the tread surface parallel to the centreline. By the circumferential distance between adjacent grooves is meant the distance along the tread surface in the circumferential direction from the longitudinal centres of adjacent grooves.

Preferably the circumferential distance between adjacent groove is one of at least twelve or more preferably twenty different distances. Most preferably each distance is unique.

FIG. 5

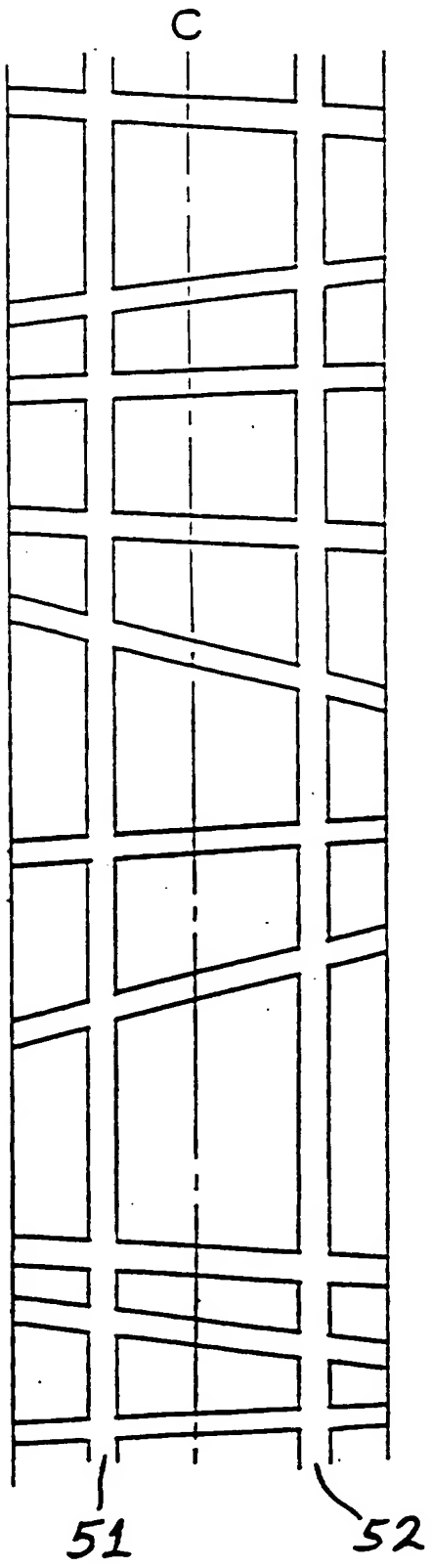
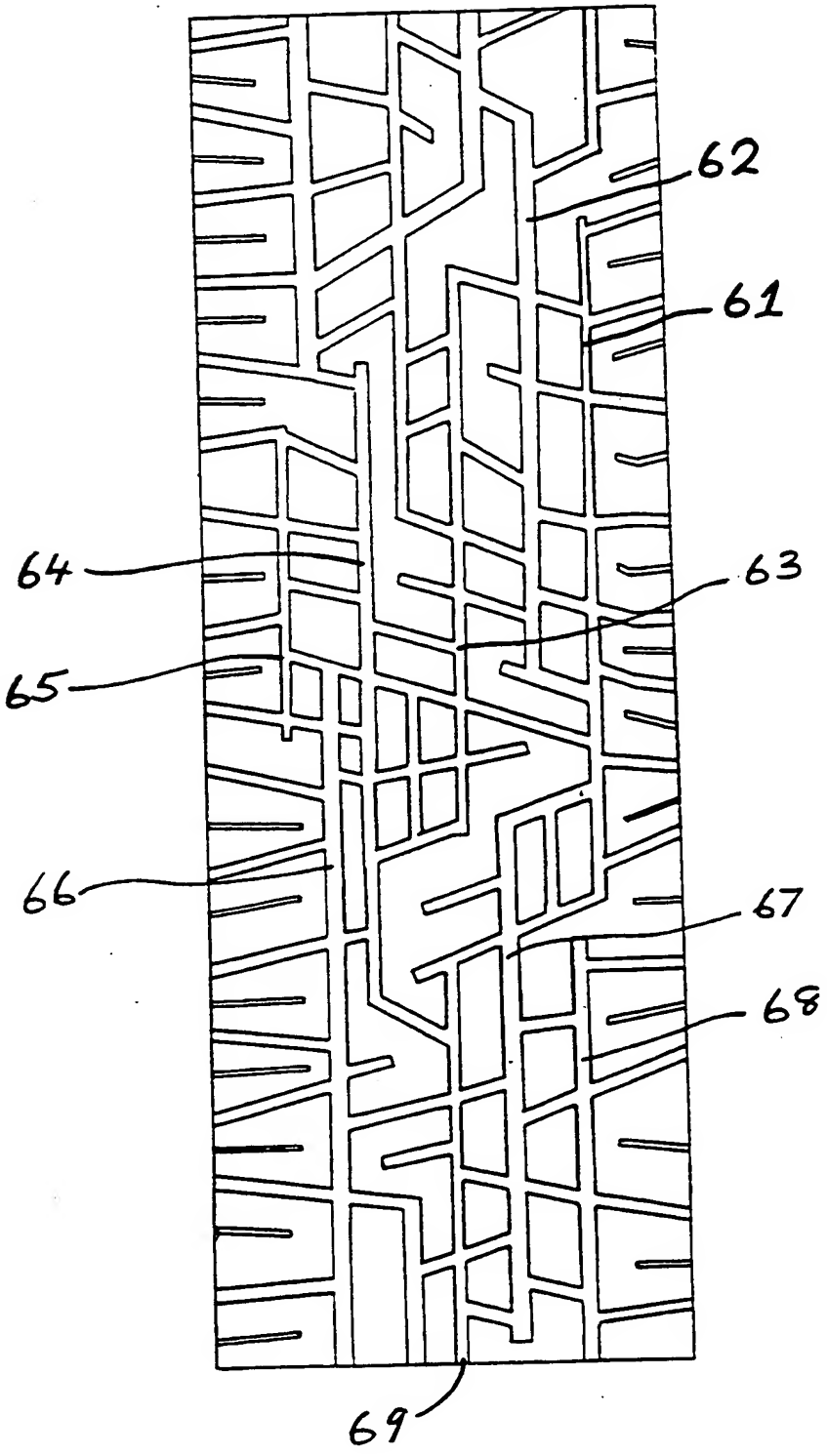


FIG. 6



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PNEUMATIC TYRE

This invention relates to a pneumatic tyre having a ground contacting tread which is particularly adapted to be quiet in running.

The problem of tyre generated noise is the subject of increasingly stricter legislation concerned with reducing overall noise levels generated by moving vehicles. Thus the problem of minimising tyre generated or so-called "pass-by" noise is becoming an increasingly important aspect of tyre design.

In order for pneumatic tyres to perform well under all conditions it is normal for the ground contacting tread region to be provided with grooves. In wet conditions such grooves assist in clearing bulk water from the contact area between the tyre tread and the road surface and thus help prevent aquaplaning in which steering control of the vehicle is lost. The arrangement of grooves in the tyre tread defines tread ribs, tread blocks or combinations of both. It is the impact of these tread ribs and blocks on the road surface as they move through the contract area between the tyre and the road which produces the tread noise.

In conventional tyres the complete tread design around the whole circumference of the tread comprises a number of repetitions of a "pattern element" which is a circumferentially short length area of full width having a particular configuration of ribs, blocks or combinations thereof. Any particular pattern element produces a unique noise spectrum having a number of dominant frequencies. It is possible to modify the noise spectrum of a pattern element by altering its pitch length. This is the basis for the conventional approach to tyre noise reduction in which pattern elements of differing circumferential lengths are employed around the tyre with the objective of spreading the dominant frequencies generated such that the total noise of the tyre tends towards so called 'white noise' which is perceived to be quieter.

Accordingly tread pattern designers typically employ 3-6 different pitch lengths of a pattern element in order to minimise tyre generated noise. Much effort has been expended in the derivation of algorithms used to determine the optimum sequencing of these different pitch lengths around the tyre circumference.

The axial grooves may extend partially or wholly across the width of the tread and the tread may further comprise circumferentially extending grooves. These circumferential grooves may be discontinuous in the circumferential direction and circumferentially adjacent grooves may also be displaced relative to each other in the axial direction.

Further aspects of the invention will become apparent from the following description by way of example only, of one embodiment with reference to the accompanying drawings in which:-

Figure 1 shows a cross-section of a pneumatic radial tyre according to the present invention;

Figure 2 shows a portion of a tyre tread of the tyre of Figure 1 according to the present invention;

Figures 3 to 6 show portions of other tyre treads according to the present invention.

Shown in cross-section in Figure 1 is a pneumatic tyre according to the present invention and having a conventional radial construction. Accordingly the tyre has a carcass ply 21 comprising radial cords extending between bead regions 25 through sidewall regions 27 and a tread region 23. In each bead

region the carcass ply 21 is secured by being turned around a circumferentially extending inextensible bead core 22 from the axially inside to the outside. The tyre tread region 23 is reinforced by a belt or breaker 26 disposed radially outward of the carcass 21.

In the first embodiment of the present invention the tyre tread 23 is provided as shown in Figure 2 with a plurality of straight grooves G extending axially perpendicular to the tread centreline. The circumferential distance between the longitudinal centrelines of adjacent grooves is one of at least eight different distances L1-L8. The grooves may be arranged such that the distances L1-L8 between adjacent grooves are sequentially incremental as shown in Figure 2 or they may be arranged differently such as in a random arrangement.

In this first embodiment of the invention the eight difference circumferential distances L1-L8 between adjacent grooves G are the same at all distances from the tyre or tread centreline C since the grooves are parallel to each other.

In a second embodiment of the invention shown in Figure 3 the axial grooves are neither perpendicular to the tread circumferential centreline C nor parallel to each other. In accordance with the invention the circumferential distances LL1-LL9, numbered in increasing magnitude, between the centres of adjacent grooves at a fixed axial distance Lx to the left of the centreline C are all different. Similarly to the right of the centreline C the circumferential separations LR1-LR9 of adjacent grooves at a different axial distance Rx are all different from each other. It may be the case of course that one or more of the distances LL1-LL9 are the same as one or more of the distances LR1-LR9, or that one or more of distances LL1-LL9 or LR1-LR9 are the same as other distances between adjacent grooves at different axial positions, i.e. at different values of Lx and Rx from the centreline C.

The axial tread grooves may also be disposed symmetrically about the tread centreline C as shown in Figure 4.

The axial grooves may extend as shown fully across the tread or may extend only across a portion of the width of the tread.

According to the present invention the tyre tread may also comprise longitudinally extending grooves to define with the axially extending grooves rows of tread blocks. These may be continuous straight grooves 51,52 as shown in Figure 5 or kinked or zigzag grooves or other grooves common in the art.

The circumferential grooves may alternatively be discontinuous. Figure 6 shows an embodiment of th present invention having discontinuous circumferential grooves 61-69 in the tread wherein circumferentially adjacent discontinuous circumferential grooves are displace relative to each other in the axial direction. In accordance with the present invention the circumferential distance between adjacent axial grooves in the tyre tread of Figure 6 is unique for every such pair of grooves.

Tyres according to the present invention have shown reduced noise levels with good wet performance.

CLAIMS

1. A pneumatic tyre comprising a ground contacting tread having a plurality of transverse grooves disposed around the tyre circumference characterised in that the circumferential distance between adjacent transverse grooves measured along a circumferentially extending straight line is one of at least eight different distances.

2. A pneumatic tyre according to claim 1, characterised in that the circumferential distance between adjacent transverse grooves is one of at least twelve different distances.

3. A pneumatic tyre according to claim 1, characterised in that the distance between adjacent grooves is one of at least twenty different distances.

4. A pneumatic tyre according to claim 1, characterised in that the distance between each pair of adjacent grooves is unique.

5. A pneumatic tyre according to any of claims 1 to 4, characterised in that the transverse grooves extend across the whole of the width of the tread.

6. A pneumatic tyre according to any of claims 1 to 5, characterised in that all the transverse grooves extend across only a part of the tread.

7. A pneumatic tyre according to any of claims 1 to 6, characterised in that the tyre has at least one groove extending circumferentially.

8. A pneumatic tyre according to claim 7, characterised in that the circumferentially extending groove is continuous around the tyre circumference.

9. A pneumatic tyre according to claim 7, characterised in that the circumferential grooves are discontinuous in the circumferential direction.

10. A pneumatic tyre according to claim 9, characterised in that circumferentially adjacent discontinuous grooves are displaced in the axial direction relative to each other.

The Patent Office

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Application No: GB 9706239.2
Claims searched: 1 - 10

Examiner: C J Duff
Date of search: 18 June 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): B7C(CDJ,CRB)

Int Cl (Ed.6): B60C 11/00, 11/03, 11/04, 11/11

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2268453 A	(JOHNSON) See Figs 5, 6	1, 6-8
X	GB 2146594 A	(GOODYEAR) Whole document	1-3, 5-8
X	EP 0528577 A1	(GENERAL TIRE) Whole document	1-3, 5-8
X	US 5560791	(KAJITA) See Fig 2	1, 7-9
X	US 5309964	(KOGURE) Whole document	1 at least
X	US 4442499	(SEKULA) Whole document	1, 7, 9

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
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